Performance Comparison of Edge Detection Operators for Supporting Lip Prints Biometric Identification

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***Abstract*—In this paper, a preprocessing method for human identification implemented on lips print Biometric system has been explored. The methods used are based on Laplacian and Sobel operators for detecting edges in lips images. Experiment has been applied successfully using custom-based lip images. The steps to perform experiment can be described as follows: (i) Acquisition of lips image, (ii) Basic pre-processing tasks and (iii) Segmentation using detection operators. Not less than 90 images have been used for recognizing lips print patterns. The experimental result showed that Sobel edge detection operator is better than Laplacian operator due to multiply kernel usage in Sobel operator.**

Keywords—Lips print, Biometric system, segmentation, Laplacian, Sobel, edge detection.

I. INTRODUCTION

There are several ways for identifying human based on body characteristics. One of the Biometric features is lips. Lips is interesting Biometric feature which has unique type. Lips are not only part of human face but also lips can be discovered on several things in the form of lips print.

The research about lips print has been done by Suzuki [1] in forensic field for lips print type classification. Then in Mansfield [2] lips print are used for human identification as part of Biometric system. In 2003, Mudjosemedi [3] found a specific area in lips print that can be used for data representation by counting number of lips print pattern. In [5,6,7] lips print that obtained by sticking lips to a white paper is a part of lips print pattern research.

Today, Biometric identification system is very important for supporting many fields. As part of Biometric features, lips can be another important modal for improving the accuracy of human identification, when it is combined with other Biometric features. Having knowledge of detecting and recognizing lips print, many and various applications can be created.

II. METHODOLOGY OF RESEARCH

A. Biometric System

Biometric system tasks consist of Data Collection, Transmission, Data Storage, Signal Processing and Decision. Data Collection is a process of image acquisition using sensor. Transmission is a process of data adjusment before storing in device. Data Storage is process of saving data in device. Signal Processing is a process of image manipulation using various algorithms. Decision is an intelligent part for selecting action that will be taken. These tasks can be viewed on Figure 2.1.

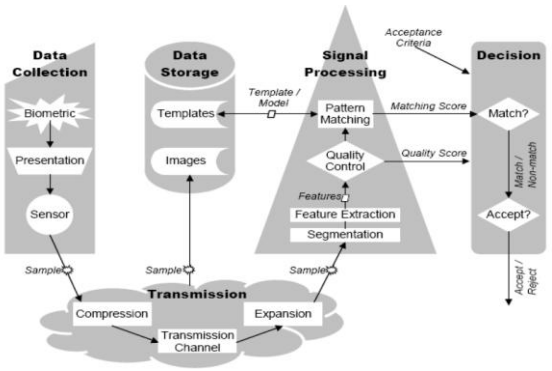


Fig.2.1. Biometrc system general [2]

B. Lips Print

Lips print is one of physical feature that can be used for individual identification. The forrow of lips print has basin and hill that can be used as lips print pattern for locating lips print. This pattern is obtained from forrow fold on lips. Regio is a specific area that is located on up and low lips.

Lips are divided into eight regios. Four regios are in the upper lips, four regios are in bottom lips. The illustration of these regios is given in Figure 2.2 [3].

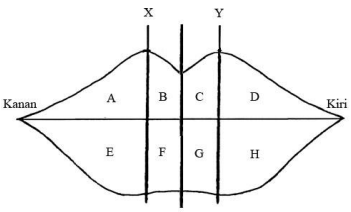


Fig.2.2. The Regions of Lips [3]

Lips print classification is categorized into 6 types [1]. Those types are (i) Type I, forrow direction is vertical, (ii) Type I', similar with type I but not completely vertical, (iii) Type II, a branched forrow, (iv) Type III, a crossing forrow, (v) Type IV, a net forrow and (vi) Type V, others than type I to IV. These types are visualize on Figure 2.3 [1].

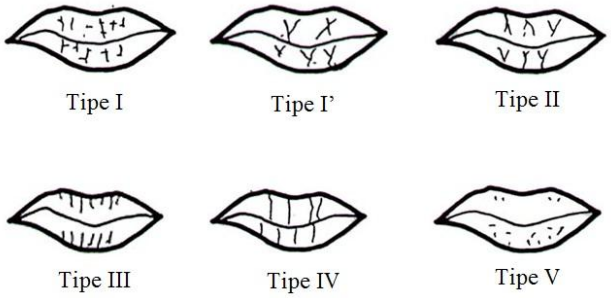


Fig.2.3. Pattern classification of lips print [1]

C. *Image Processing*

Digital image processing algorithms are applied for manipulating lips print images. Specifically, grayscale and histogram equalization algorihms are used for enhancing lips print [4]. Grayscale process will change the true-color of lips print image that has difference pixel value of RGB (Red, Green, Blue) to the same value of RGB. The formula for this process is presented below:

$$Gray = \frac{R + G + B}{3} \tag{2.1}$$

Histogram Equalization will enhance the lighting by equalizing pixels distribution of lips print image using the formula:

$$s_k = T(r_k) = (L-1)\sum_{j=0}^{k} p_r(r_j) = \frac{(L-1)}{MN}\sum_{j=0}^{k} n_j \tag{2.2}$$

D. *Laplacian and Sobel Operator*

Laplacian operator can be used for edge detection. It applied 3x3 matrix size, that is convolved into lips print image. Laplacian operator can be used on true color image including grayscale image [8,9]. Example of Laplacian operator is given on Figure 2.4.

0	1	0
1	-4	1
0	1	0

Fig.2.4. The Laplacian operator

Sobel operator has a value as weight 2 on middle matrix for horizontal and vertical direction, with assumption that the middle of matrix gives the larger contribution than the other matrix [4,10,11]. Example of Sobel operator is given on Figure 2.5. In horizontal Sobel operator, there are horizontal zeros in the middle; In vertical Sobel operator, there are vertical zeros in the middle; In +45 and -45° Sobel operators, there are negative and positive diagonal zeros.

-1	-2	-1		-1	0	1		0	1	2		-2	-1	0		
0	0	0		-2	0	2		-1	0	1		-1	0	1		
1	2	1		-1	0	1		-2	-1	0		0	1	2		
(a)				(b)				(c)				(d)				

Fig. 2.5. The Sobel operator (a) horizontal, (b) vertical, (c) +45°, (d) -45°

III. EXPERIMENT AND RESULT

The experimental are divided into three steps: (i) Acquisition, (ii) Basic pre-processing and (iii) Segmentation. The acquisition step is lips image capture, focussed on the lips area. The other part of face is not captured. The basic pre-processing step is marking ROI (Region of Interest) from lips print area and converted into grayscale image and equalize for distributing the lightness. The Segmentation step is applying Laplacian and Sobel operator to obtain lips print patterns. The steps are diagrammed in Figure 3.1.

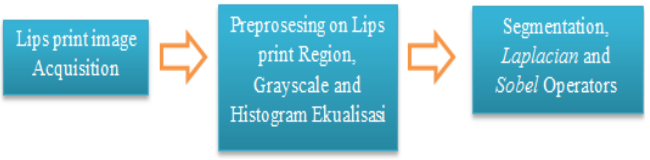


Fig. 3.1. The Steps of Lips print Segmentation

A. *Acquisition and Basic pre-processing of lips print*

Image acquisition is performed to obtain 90 lips print images from 30 persons. The format of the image is bitmap (.bmp) extension format.

The lips print image is focussed on the lips without the other face objects. This is perform for improving processing [3]. Lips print images will be cropped on regio B to C (upper lip) and F to G (bottom lip). This process is perform manualy and displayed on Figure 3.2.

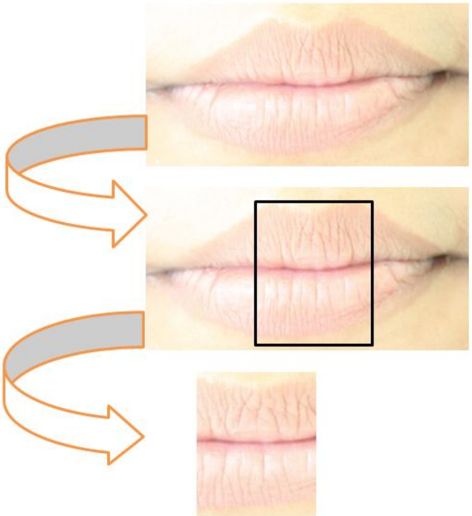


Fig. 3.2. The preprocessing of lips image

Grayscale algorithm is applied to the cropped image. The true color image is converted into grayscale image. This is done to normalizing the lips image, especially for processing lipstick color. Grayscale image is then normalize using histogram equalization algorithm. This process will enhance the lips print images so the lips pattern can be seen clearly. This process is illustrated on Figure 3.3.

Fig. 3.3. The Grayscale and Histogram Equalitation of true color lips image.

B. *Segmentation Process*

Lips print image that is used for segmentation process is the result of previous step. Segmentation process is conducted using two edge detection operators, those are Laplacian operator and Sobel operator. The preprocessed image is segmented using each operator in paralel manner.

The result of segmenting preprocessed image using the Laplacian operator can be seen on Figure 3.4 (a). Laplacian operator changed the forrow into dots. This result gave less informed lips print patterns. This is caused by single kernel usage therefore the pixel values are not accumulated.

The result of segmenting preprocessed image using the Sobel operator can be seen on Figure 3.4 (b). Sobel operator used four kernels as described before, so the result is more informative.

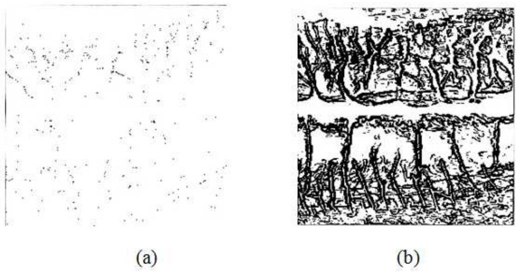
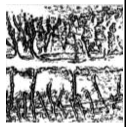
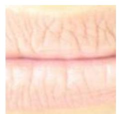
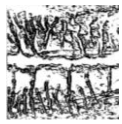
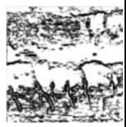
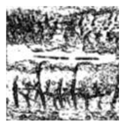


Fig. 3.4. The Segmentation process by Laplacian (a) and Sobel (b) operator.

In the Table 3.1 is shown the partial result (9 of 90 lips images) of the preprocessing and segmentation processes.

TABLE 3 I. SEGMENTATION RESULT OF LIPS PRINT IMAGES

True color lips image	**Result of *Laplacian* operator**	**Result of *Sobel* operator**	**Pattern of lips print**
			*Sobel*
			*Sobel*
			*Sobel*
			*Sobel*
			*Sobel*
			*Sobel*

IV. CONCLUSION AND FUTURE WORKS

Lips print is a promising Biometric feature which has unique and special characteristics. If it is combined with other Biometric modals, it will be a powerful and realible method for human identification including forensic application.

This paper described how preprocessing task is performed to prepare lips print images for future step such as detection and recognizing lips as part of human body. Two methods are applied successfully using 90 lips images taken from 30 people. It is shown that Sobel operator is more powerful than Laplacian operator for segmenting the lips images. It can be concluded that Sobel operator can be used for improving lips print image.

The next works can be performed by applying other edge detection operator such as Channy to compare with Sobel operator. The future research can be conducted using the preprocessed lips image for detecting and recognizing human.

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